

- 12 -

## CLAIMS

1. Apparatus for the production and detection of  
fluorescence at or below a surface, said apparatus  
5 comprising:

a light source for directing fluorescence excitation  
light along a light path extending over a said surface;

- 10 a reflector having a three dimensionally curved, shell-  
like light reflecting interface positioned to receive  
light from the light source passing over said surface  
along a portion of said light path and to reflect said  
light transversely with respect to said portion of the  
15 light path so as to focus said light on an illumination  
zone at or below said surface for stimulation of  
fluorescence at said zone, and to collect fluorescence  
light emitted at said zone and to reflect and at least  
partially collimate said light to pass back along said  
20 portion of the light path; and

a detector for receiving said light emitted as  
fluorescence after reflection at said interface.

- 25 2. Apparatus as claimed in Claim 1, further comprising a  
beam splitter reflecting light emitted by said light  
source to pass to said reflector and receiving  
fluorescence light from said reflector and passing said  
fluorescence light to said detector.

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3. Apparatus as claimed in Claim 2, wherein said  
reflector, light source and detector are arranged in a

- 13 -

generally coplanar manner and said beam splitter has a planar reflective interface that lies in a plane orthogonal to the co-planarity of the reflector, light source and detector.

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4. Apparatus as claimed in any preceding claim, further comprising an excitation filter selecting an excitation wavelength from the light emitted by the light source to pass to said reflector.

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5. Apparatus as claimed in any preceding claim, further comprising an emission filter selecting an emitted fluorescence wavelength to pass to said detector.

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6. Apparatus as claimed in any preceding claim, comprising a lens or a second reflector focussing fluorescence light on said detector.

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7. Apparatus as claimed in any preceding claim, wherein said reflector interface substantially has the form of a partial paraboloid, aspheric, toroidal, or biconic surface.

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8. Apparatus as claimed in Claim 7, wherein said reflector interface is defined by an equation

$$Z = \frac{cr^2}{1 + \sqrt{1 - (1+k)c^2r^2}}$$

wherein:

c is from 0.07 to 0.5 and k is from -1.5 to -0.7, where z is the "sag" of z-coordinate along the rotational axis, c is the curvature (the reciprocal of the radius

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- 14 -

R), k is the conical constant and r is the radial coordinate.

9. Apparatus as claimed in Claim 7 or Claim 8, wherein  
5 said reflector interface includes that part of a paraboloid, aspheric, toroidal, or biconic surface that is generated by the cutting of a paraboloid, aspheric, toroidal, or biconic surface by a right circular cylinder erected centred on the illumination zone.
10. Apparatus as claimed in Claim 7 or Claim 8, wherein  
said reflector interface substantially has the form of a part of a half paraboloid.
11. Apparatus as claimed in any preceding claim, further  
15 including a housing containing the light source, reflector and detector and having a base surface containing a window for passing excitation light out of the housing and receiving fluorescence light into the  
20 housing and being for engagement in use against the said surface at or below which said fluorescence occurs.
12. Apparatus as claimed in any preceding claim, wherein  
25 said light path makes an angle of no more than 10 degrees with a plane defined by said base surface.